CENTER FOR INNOVATION THROUGH VISUALIZATION & SIMULATION

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Building Large Scale 3D Models from LiDAR Data

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Advisors Committee
Professor Chen Zhou
Professor Barbara Jean Nicolai
Professor Lash Mapa

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Project Objective

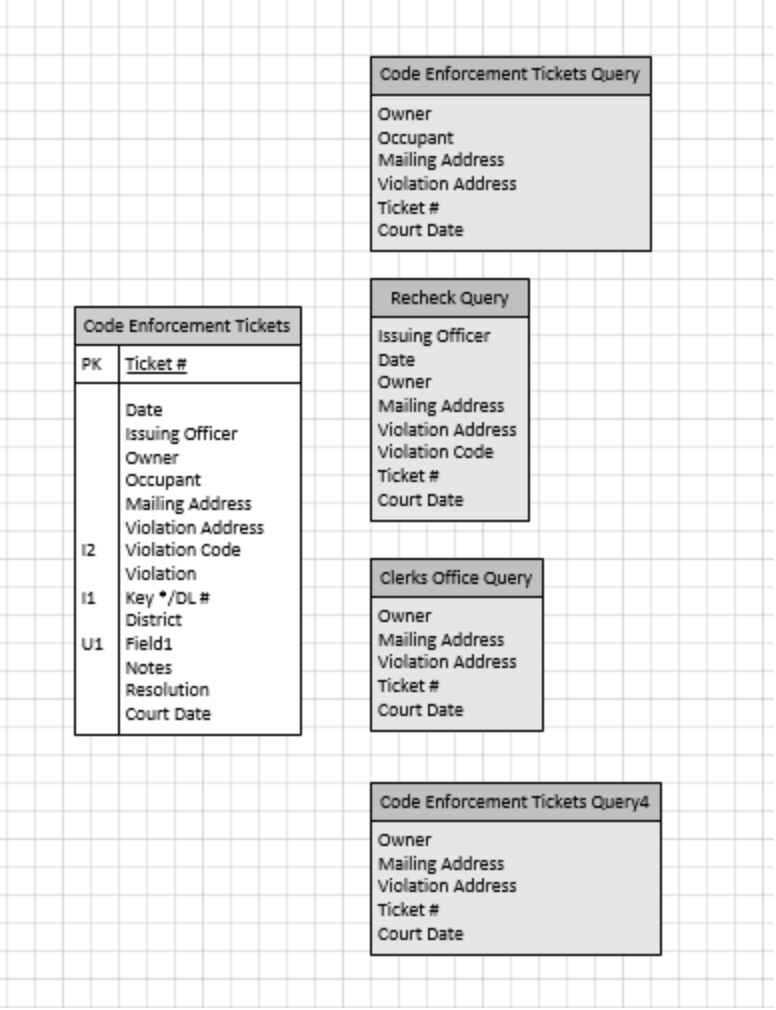
- Develop Architecture for an Operational Database for the City of Gary Department of Code Enforcement
  - Using Existing Code Enforcement Data
- Develop a 3D Models of Gary, Hammond, and Munster
  - Using LiDAR Data
- Analyze and display Data
  - Display Data Analysis using 3D Model
- Mobile 3D App

DATABASE ARCHITECTURE

3

EXISTING CODE ENFORCEMENT DATABASE

- The current method of data management in the Code Enforcement Department is:
  - MS Access Database with no relationships
  - a series of MS Excel
    - Monthly Report
    - Annual Report



EXISTING SYSTEM

- This system has been in place since 2012 and contents over 8,000 records.
- The existing DB is a single table with no relationships.
- There are four (4) queries that have been built to extract report data from the table.
- Send violations to the City Clerk's Office to establish the City Court docket.

EXISTING PROCESS

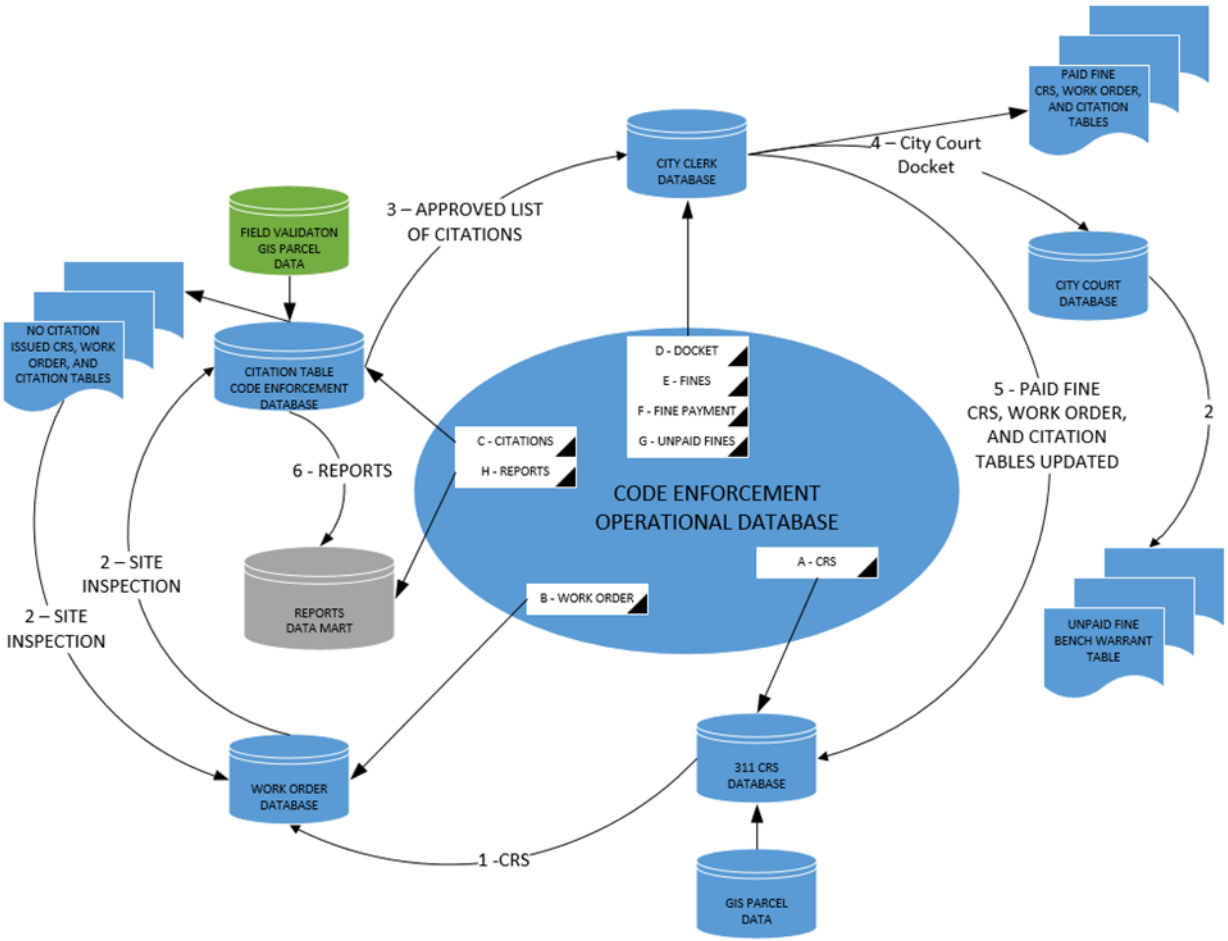
- Citizen Request for Services(CRS) is opened via the 311 system
- Based on the address a CRS is assign to a Code Enforcement Officer (CEO)
- CEO has a makes a site visit and either issue a citation with court date or closes the CRS
- Office Manager manually enters citation into database and mails court summons to owner of record
- Office Manager prepares and send list of citations to City Clerk to have the place on the next City Court Docket
- City Clerk prepares the docket

EXISTING PROCESS

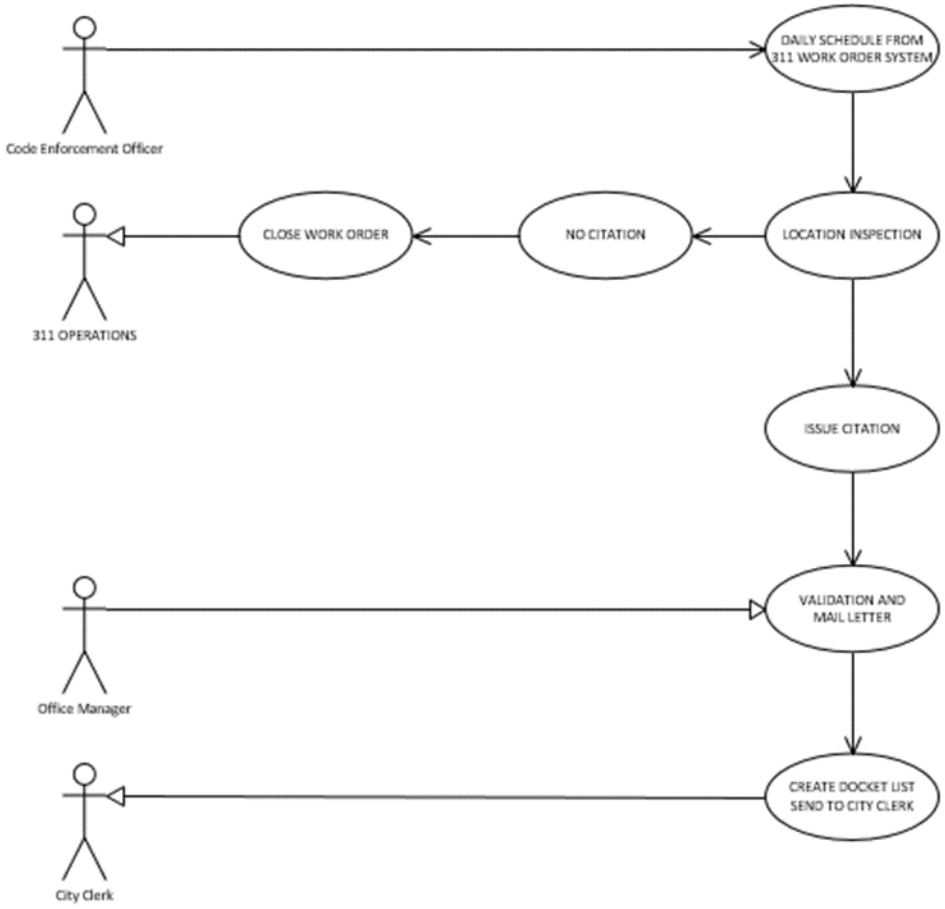
- Court date one of three (3) outcomes
  - Fine is issued
  - Case dismissed – CRS Closed
  - Continuance Grant
- Fine paid – CRS Closed
- Fine not paid by court appointed date
  - Bench Warrant issued

SYSTEM ANALYSIS

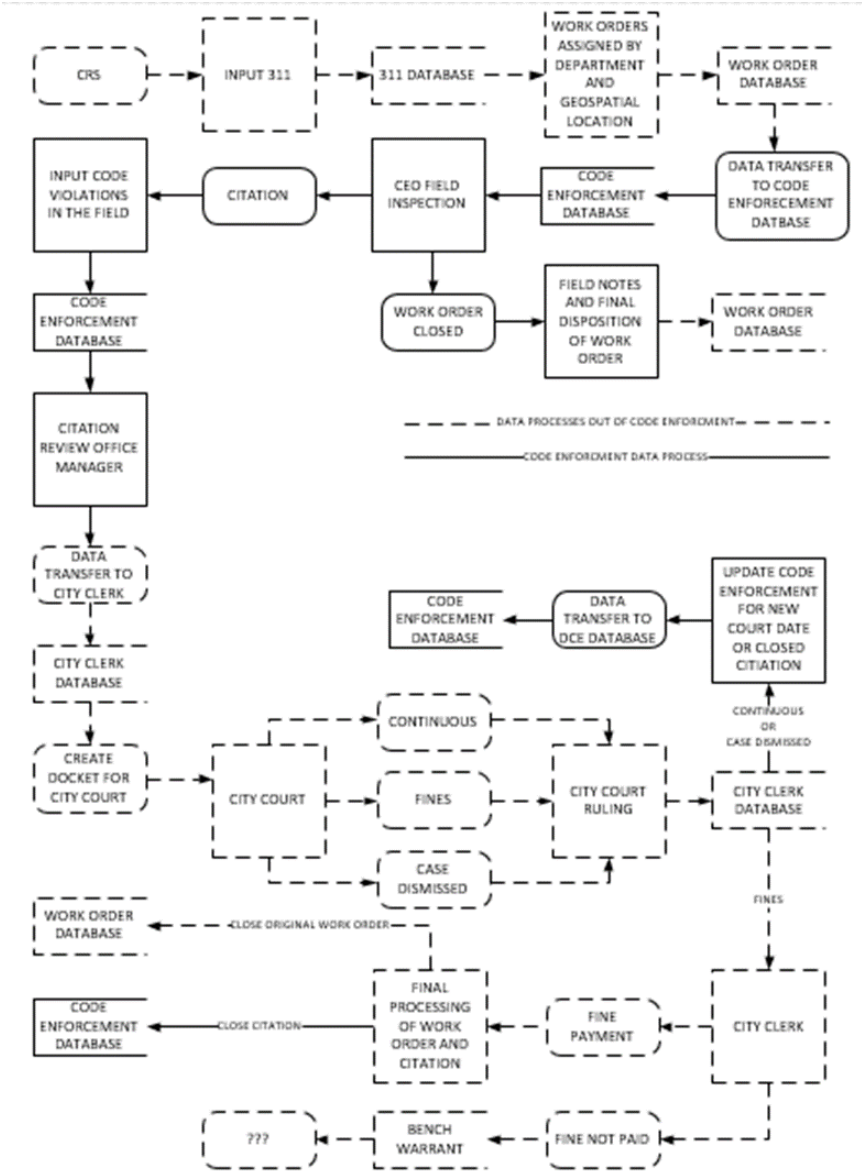
PROPOSED DEPARTMENTAL DATA FLOW



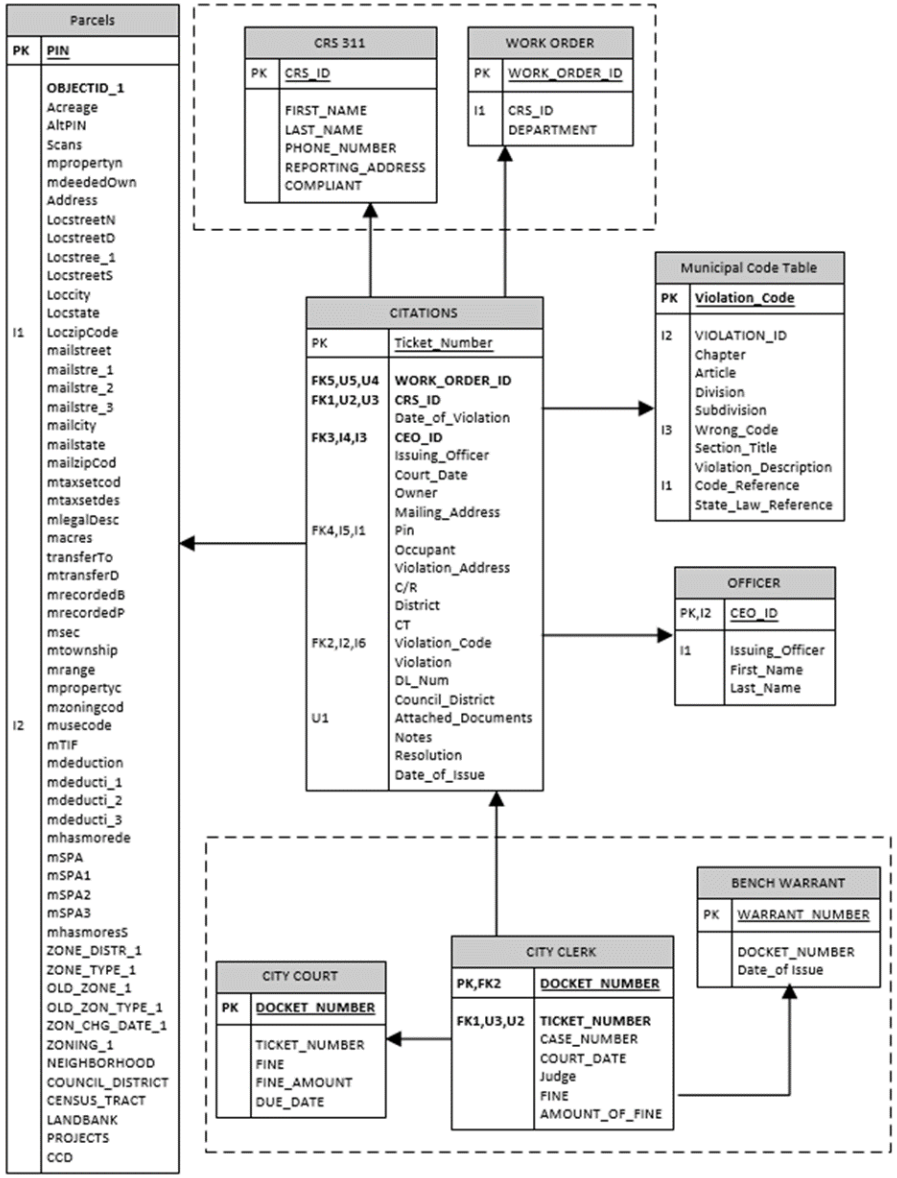
PROPOSED USE CASE - NEW CITATION



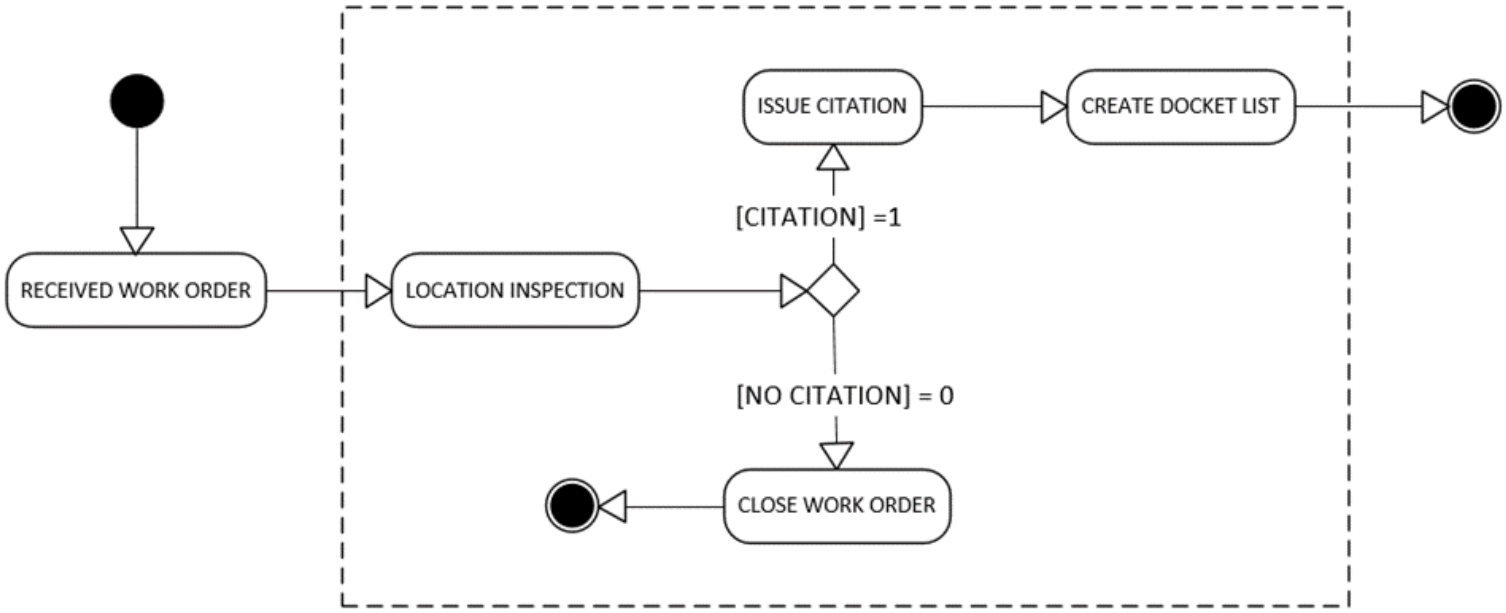
PROPOSED CODE ENFORCEMENT WORKFLOW



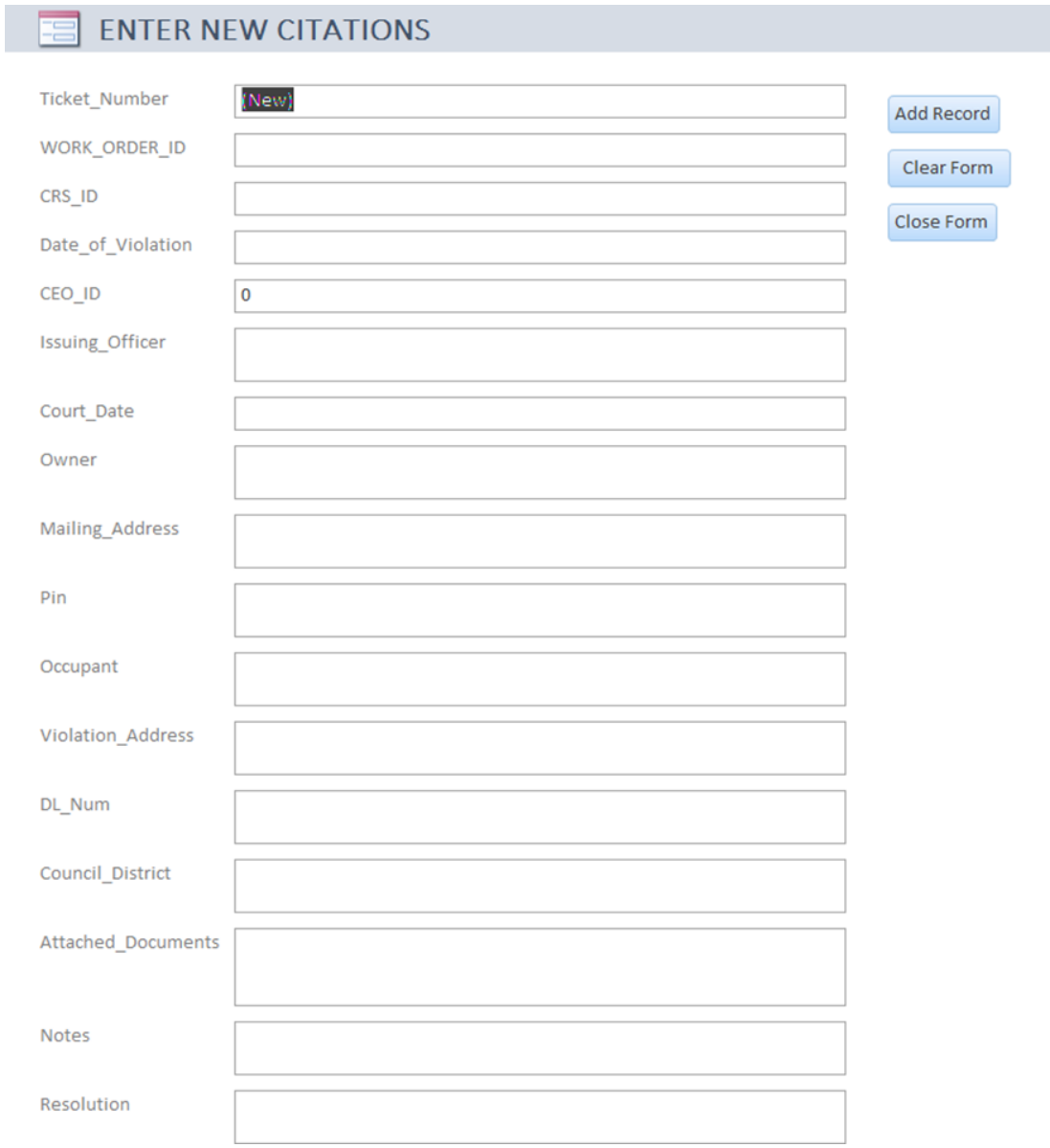
PROPOSED ENTITY RELATIONSHIP DIAGRAM



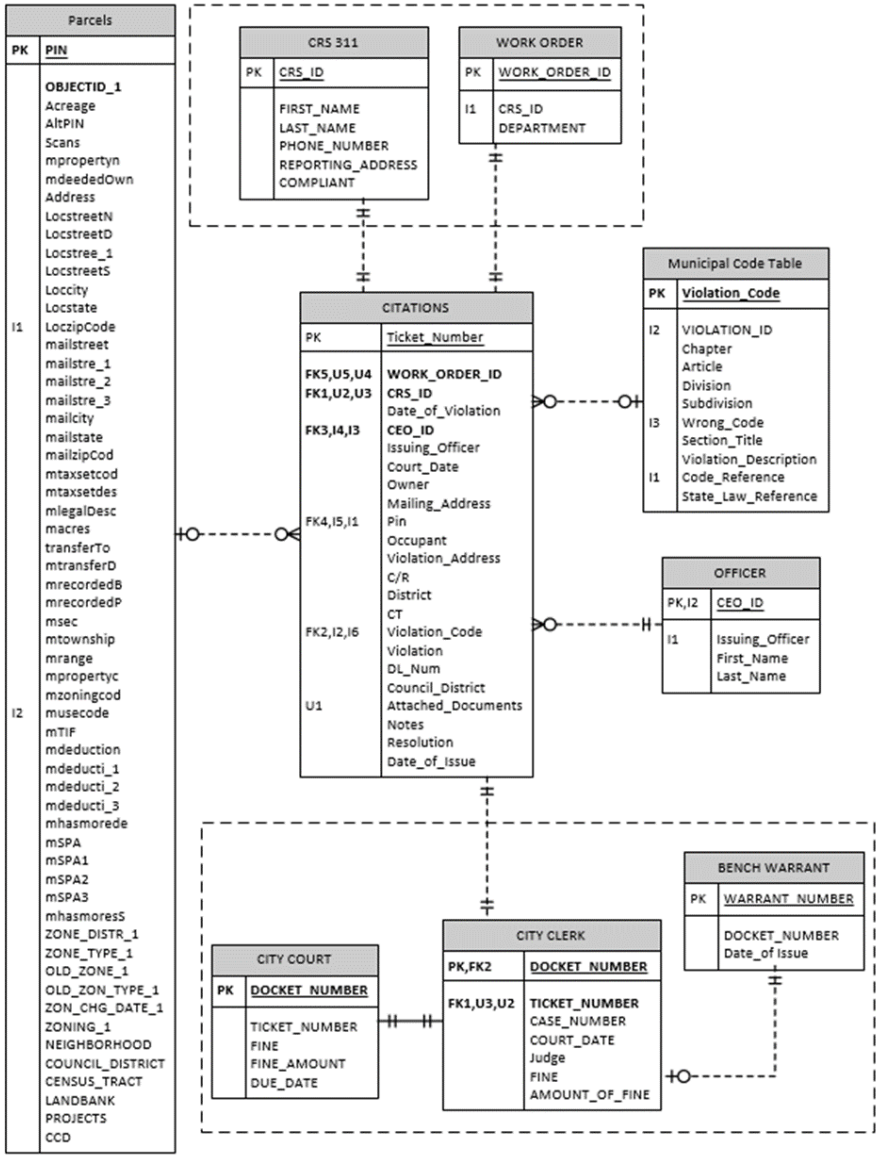
PROPOSED STATECHART NEW CITATIONS



PROPOSED ENTER NEW CITATION



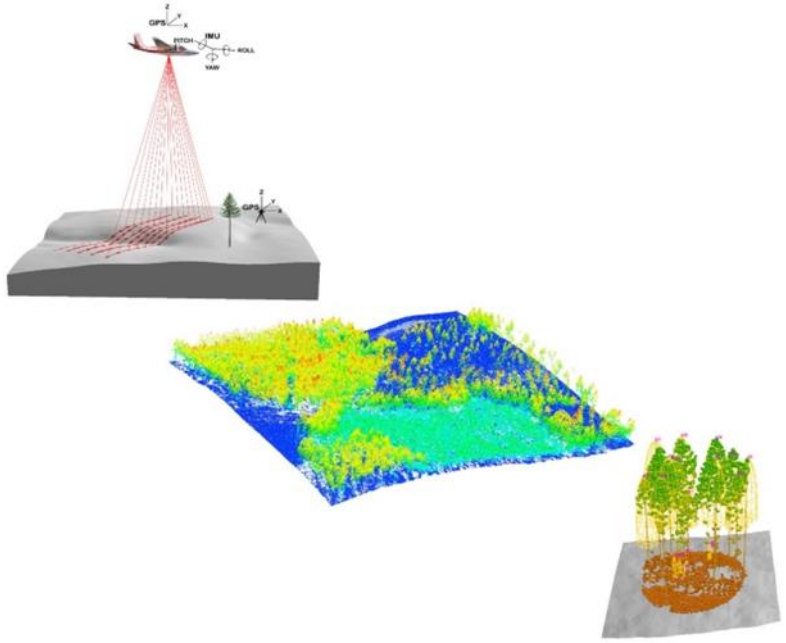
PROPOSED ENHANCED ENTITY RELATIONSHIP DIAGRAM



LiDAR Data

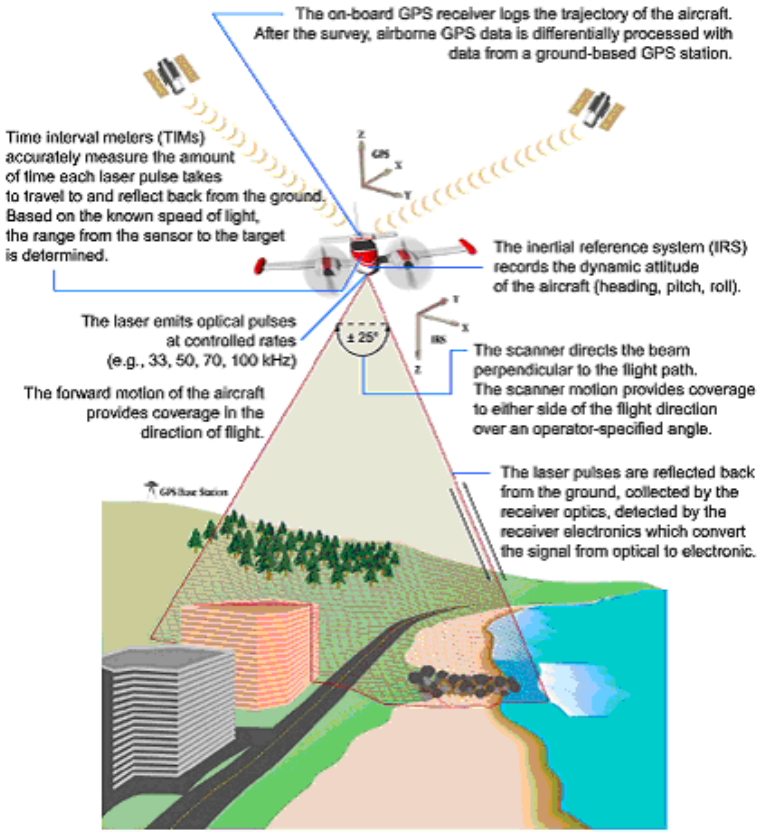
2011-2013 Indiana Statewide Orthoimagery Program

LiDAR
Light Detection And Ranging



LiDAR COLLECTION

1. A laser pulse is transmitted
2. Electronics within the system record the time of the pulse's transmission
3. Timing stops when the reflection of the pulse is detected by the system's receiver optics
4. Range is calculated by using the speed of light. This occurs at a speed between 33000 to 100000 times per second
5. Range is then merged with the aircraft's trajectory, correct for shifts, platform offsets to generate georeferenced ranges.



Post-flight processing combines the 3 key data streams: 1) GPS (aircraft trajectory), 2) POS (aircraft heading, pitch, roll), 3) LIDAR (range, scan angle). Processed point data is graphically rendered by visualization software as a digital elevation model (DEM).

TYPES OF FLIGHTS

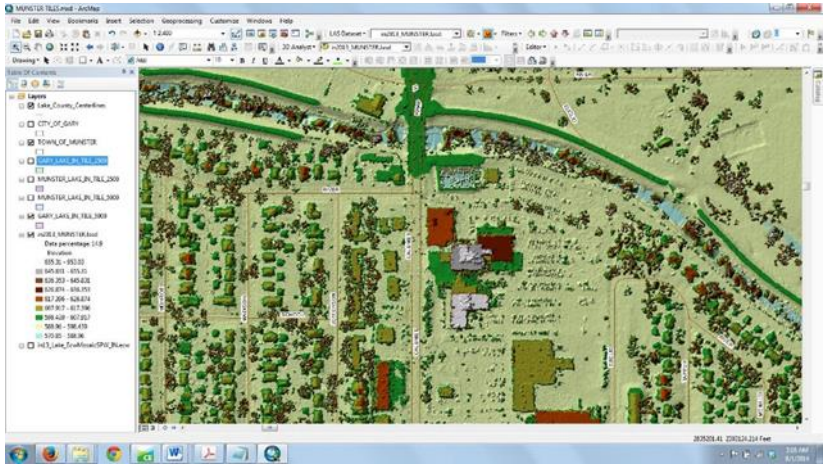
1. Leaf on flights is typically flown for agricultural, forestry both urban and rural, and low and medium vegetation studies and data collection.

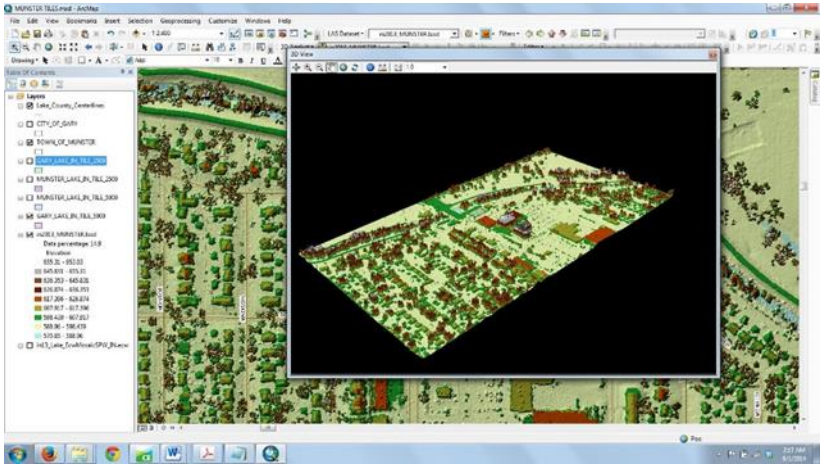
2. Leaf off flights is typically flown for urban data collection, hydrology and bare earth studies, land management and development.

3. Oceanography flights are typically flown for measuring water depths without direct contact with the water body or without any instrument mounted on the water surface in shallow regions.

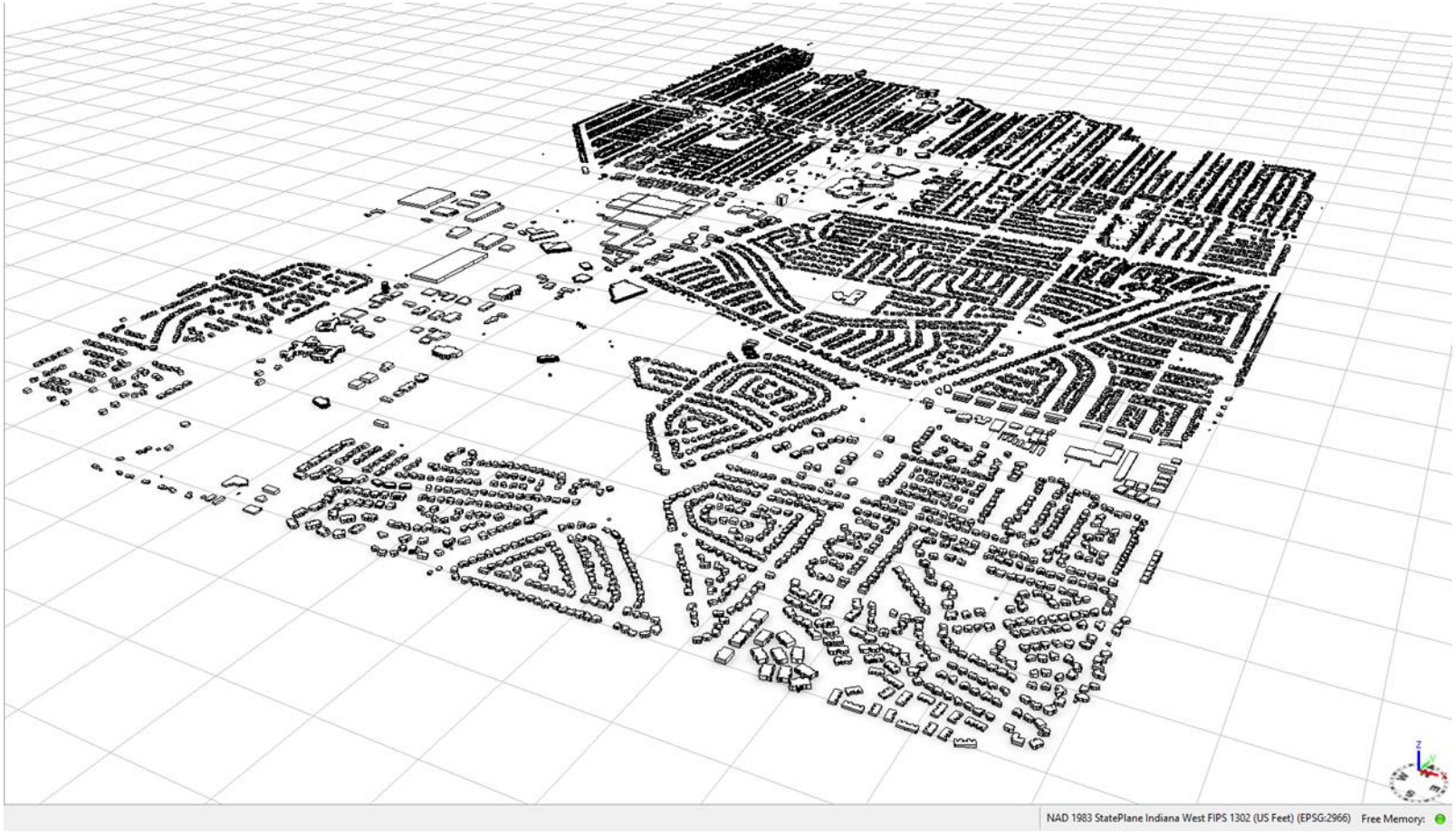
MODELING

LiDAR DATASET





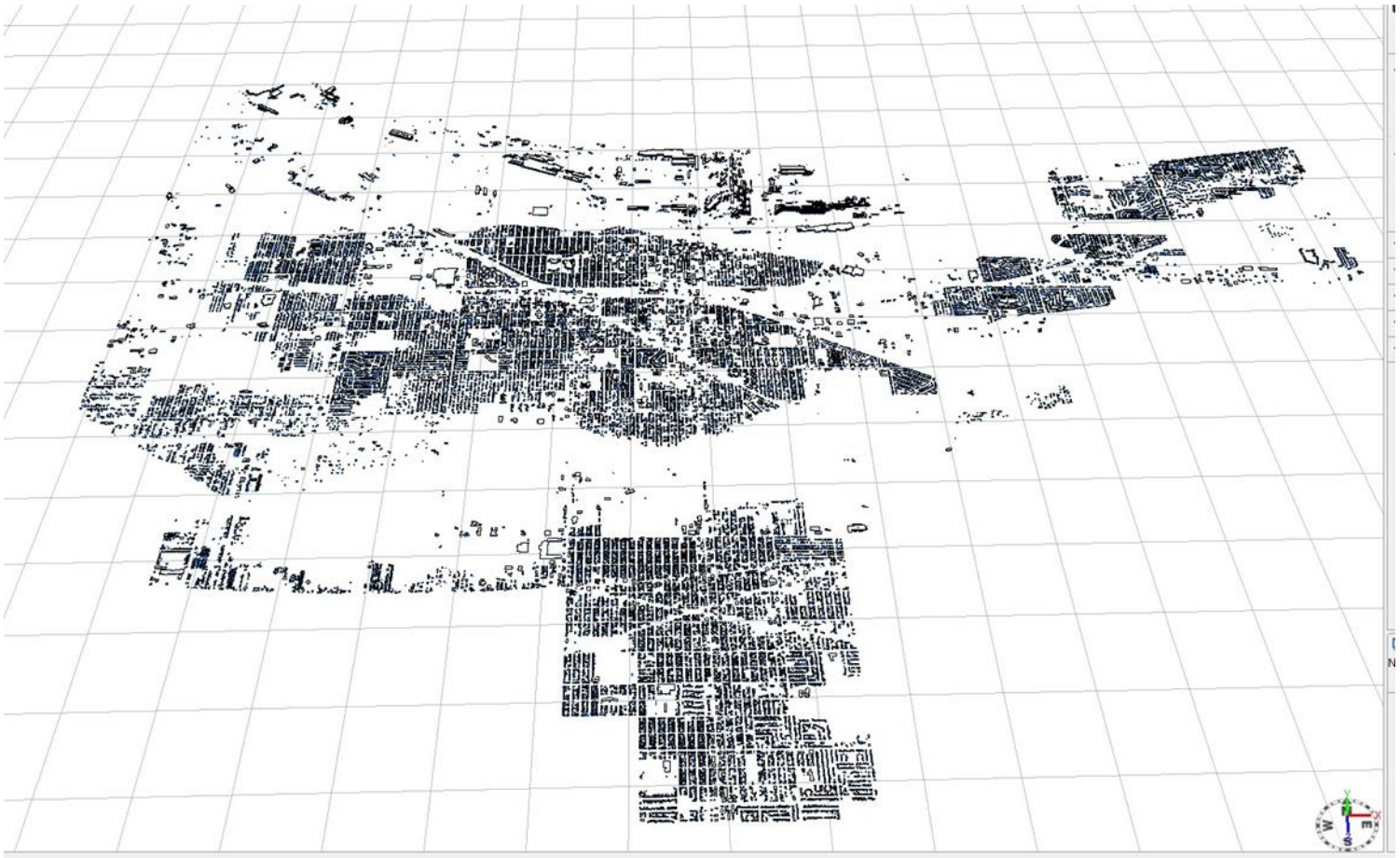
MUNSTER – 11,109 BUILDINGS



PURDUE CAMPUS – 1211 BUILDINGS

PURDUE CAMPUS – ARC SCENE

CITY OF GARY – 47,009



2D MODEL

3D MODEL


Table of Contents
Scene layers
COS_Street_Centerlines
GRADED_BUILDS_Procedurally
grade_numb
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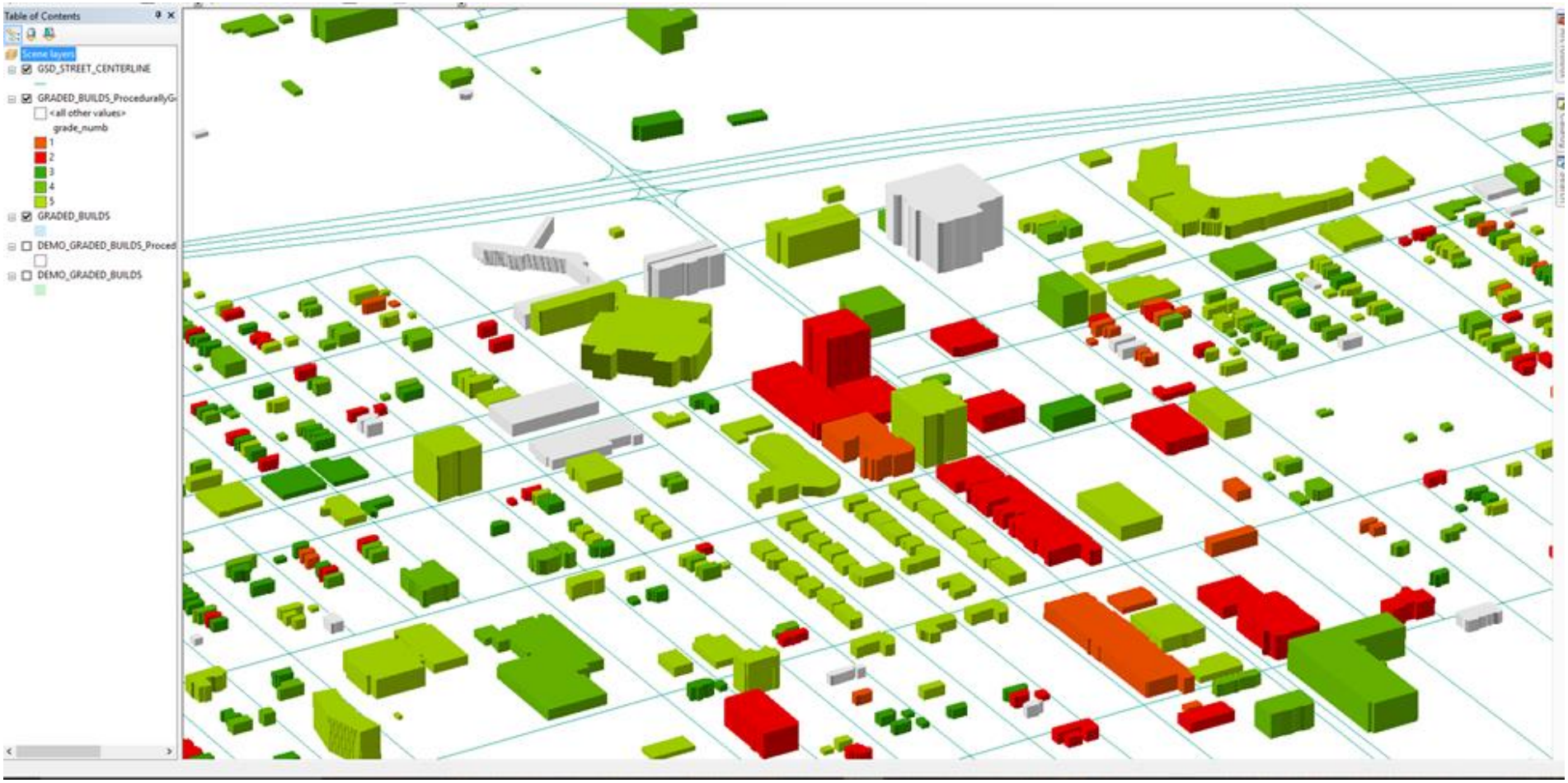
0
1
2
3
4
5
GRADED_BUILDS
grade_numb
<Null>
0
1
2
3
4
5

ORIGINAL MODEL

UPDATED MODEL



UNIVERSITY PARK – CENSUS TRACTS

3D APP

- THERE SEVERAL SOURCES THAT PROVIDE 3D MODELS OF GARY
  - GOOGLE EARTH
  - GOOGLE EARTH PRO
  - EARTH VIEW

- NONE OF THESE SOURCE PROVIDE A NON-FEE BASE METHOD OF UPLOADING AN INDEPENDENT MODEL

RECOMMANDATIONS

- COG OBTAIN A DIGITAL COPY OF THE MUNICIPAL CODE
- COG BUILD THE CODE ENFORCEMENT DATABASE WITH A 2D APP
- COG CONTINUE WORKING TO DEVELOP DATA VISUALIZATION

THANK YOU

2013 State of Indiana LiDAR data processed by:

University of Vermont Spatial Analysis Laboratory
Rubenstein School of Environment & Natural Resources
205 George D. Aiken Center
Burlington, VT 05405-0088
Jarlath O'Neil-Dunne, Director
https://www.uvm.edu/rsenr/sal/

THANK YOU

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THANK YOU

QUESTIONS

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